both in position and in pitch, the body was displaced by a twist about this screw and was then released. As the forces were uncompensated, the body of course commenced to move, but the oscillations were of unparalleled simplicity. With the regularity of a pendulum the body twisted to and fro on this screw, just as if it were actually constrained to this motion alone. The committee were delighted to witness a vibration so graceful, and, remembering the complex nature of the ordinary oscillations, they appealed to Mr. Anharmonic for an explanation. This he gladly gave, not by means of complex formulæ, but by a line of reasoning that was highly commended by Mr. Commonsense, and such that even Mr. Querulous could understand.

"This pretty movement," said Mr. Anharmonic, "is due to the nature of the screw $\alpha_1$. Had I chosen any screw at random, the oscillations would, as we have seen, be of a very complex type; for the displacement will always evoke an uncompensated wrench, in consequence of which the body will commence to move by twisting about the instantaneous screw corresponding to that wrench; and of course this instantaneous screw will usually be quite different from the screw about which the displacement was made. But you will observe that $\alpha_1$ has been chosen as a screw in the instantaneous system, corresponding to one of the double screws in the $\theta$ and $\phi$ systems. When the body is twisted about $\alpha_1$ a wrench is evoked on the double screw, but as $\alpha_1$ is itself the instantaneous screw, corresponding to the double screw, the only effect of the wrench will be to make the body twist about $\alpha_1$. Thus we see that the body will twist to and fro on $\alpha_1$ for ever. Finally, we can show that the most elaborate oscillations the body can possibly have may be produced by compounding the simple vibrations on these screws $\alpha_1$, $\alpha_2$, &c."

Great enlightenment was now diffused over the committee, and even Mr. Querulous began to think there must be something in it. Cordial unanimity prevailed among the members, and it was appropriately suggested that the screws of simple vibration should be called *harmonic screws*. This view was adopted by the chairman, who said he thought he had seen a similar expression in "Thomson and Tait."

The final meeting showed that real dynamical enthusiasm had been kindled in the committee. Vistas of great mathematical theories were opened out in many directions. One member showed how the theory of screws could be applied not merely to a single rigid body but to any mechanical system whatever. He sketched a geometrical conception of what he was pleased to call a *screw-chain*, by which he said he could so bind even the most elaborate system of rigid bodies that they would be compelled to conform to the theory of screws. Nay, soaring still further into the empyrean, he showed that all the instantaneous motions of every molecule in the universe were only a twist about one screw-chain while all the forces of the universe were but a wrench upon another.

Mr. One-to-One expounded the "Ausdehnungslehre," and showed that the theory of screws was closely related to parts of Grassman's great work; while Mr. Anharmonic told how Plücker, in his celebrated "Neue Geometrie des Raumes," had advanced some distance towards the theory of screws, but still had never touched it.

The climax of mathematical eloquence was attained in the speech of Mr. Querulous, who, with new-born enthusiasm, launched into appalling speculations. He had evidently been reading his "Cayley," and had become conscious of the poverty of geometrical conception arising from our unfortunate residence in a space of an arbitrary and unsymmetrical description.

"Three dimensions," he said, "may perhaps be enough for an intelligent geometer. He may get on fairly well without a four-dimensioned space, but he does most heartily remonstrate against a flat infinity. Think of infinity," he cries, "as it should be, perhaps even as it is. Talk not of your scanty straight line at infinity and your miserable pair of circular points. Boldly assert that infinity is an ample quadric, and not the mere ghost of one; and then geometry will become what geometry ought to be. Then will every twist resolve itself into a right vector and a left vector, as the genius of Clifford proved. Then will the 'theory of screws' shed away some few adhering deformities, and fully develop its shapely proportions. Then will——" But here the chairman said he feared the discussion was beginning to enter rather wide ground. For his part he was content with the results of the experiments, even though they had been conducted in the vapid old space of Euclid. He reminded them that their labours were now completed, for they had ascertained everything relating to the rigid body which had been committed to them. He hoped they would agree with him that the inquiry had been an instructive one. They had been engaged in the study of Nature. They had approached the problems in the true philosophical spirit, and the rewards they had obtained proved that

> "Nature never did betray
> The heart that truly loved her."

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## *NOTES.*

At a public meeting held on Tuesday in Newcastle, under the presidency of the Mayor, Sir B. L. Brown, it was finally decided, on the motion of the Sheriff, Alderman W. H. Stephenson, seconded by Prof. Philipson, head of the medical staff at the Royal Infirmary, that a cordial invitation should be sent to the British Association to hold their annual meeting in Newcastle in 1889. It was stated that the necessary amount to cover expenses would be £4000, and of this £1700 had been already subscribed.

The New York meeting of the American Association for the Advancement of Science seems to have been very successful, although the attendance was not so large as had been expected. The next meeting will be held in Cleveland, O. An invitation from Toronto came just too late. The following are the officers for the next meeting:—President, J. W. Powell, of Washington; Vice-Presidents, Ormond Stone, of the University of Virginia, (Mathematics and Astronomy), A. A. Michelson, of Cleveland, (Physics), C. E. Munroe, of Newport, (Chemistry), Calvin M. Woodward, of St. Louis, (Mechanical Science), George H. Cook, of New Brunswick, (Geology and Geography), C. V. Riley, of Washington, (Biology), C. C. Abbot, of Trenton, (Anthropology), C. W. Smiley, of Washington, (Economic Science and Statistics); Permanent Secretary, F. W. Putnam, of Cambridge, (office, Salem, Mass.); General Secretary, J. C. Arthur, of La Fayette; Secretary of the Council, C. Leo Mees, of Athens; Secretaries of the Sections, C. L. Doolittle, of Bethlehem, (Mathematics and Astronomy), A. L. Kimball, of Baltimore, (Physics), William L. Dudley, of Nashville, (Chemistry), Arthur Beardsley, of Swarthmore, (Mechanical Science), George H. Williams, of Baltimore, (Geology and Geography), N. L. Britton, of New York, (Biology), Frank Baker, of Washington, (Anthropology), Charles S. Hill, of Washington, (Economic Science and Statistics).

The twenty-fourth annual meeting of the British Pharmaceutical Conference was opened on Tuesday in the Chemical Theatre of Owens College, Manchester. There was a large attendance of members of the Association. Mr. S. R. Atkins, of Salisbury, occupied the chair, and in his presidential address invited the attention of the Conference to "a brief review of the Victorian era as it more especially affected themselves as pharmacists."

The International Astronomical Congress met at Kiel on Monday, in the large hall of the University, under the presidency of Privy Councillor Dr. Auwers, of Berlin. There was a large assembly of astronomers, including delegates from Austria, France, Sweden and Norway, and America. The delegates were received on behalf of the Government by Herr Steinmann, Civil Governor of the province of Schleswig-Holstein, and on the part of the University by the Rector, Prof. Harsen. Dr. Auwers, in replying, thanked the Prussian Government for the interest which it had manifested in the Congress.

The Hygienic Congress, which will meet in Vienna next month, will be attended by over 1400 delegates from all countries. The programme includes excursions to the Kahlenberg, the Semmering, Buda-Pesth, and Abbazzia.

The Academy of Aërostation of France has presented a medal to M. Mendeleieff, in recognition of the pluck exhibited by him at Klin on August 19, when he went up alone in a balloon, although he had never been in one before. The Russian Ambassador in Paris has undertaken to transmit the medal to M. Mendeleieff.

THE *Ceylon Observer* of August 1 announces the death on July 31 of Mr. W. Ferguson at the age of sixty-seven. Mr. Ferguson arrived in Ceylon in December 1839, and at once entered upon the arduous duties of Surveyor to the Government, a post which he filled for many years. He finally relinquished it very much shattered in constitution from exposure to climate. He was an enthusiastic naturalist, and employed the opportunities his profession afforded him for observation with pleasure to himself and advantage to others. Botany especially profited by his knowledge and exertions. He contributed largely to Thwaites's "Enumeratio Plantarum Zeylaniæ," and also to other works relating to the vegetation of Ceylon ; and his aid was warmly acknowledged by the various authors whom he assisted. He was of much service to the Eclipse Expedition of 1871.

THE death is announced of Dr. Vincenz Kosteletzky, formerly Professor at the University, and the Director of the Botanical Gardens, at Prague. He died on August 19 at the age of eighty-seven.

THE Council of the Institution of Civil Engineers has issued a list of subjects on which it invites original communications. For approved papers the Council has the power to award premiums, arising out of special funds bequeathed for the purpose.

THE *Times* of Tuesday printed some notes about the eclipse which had reached German papers from Siberia and various stations in the Russian eastern provinces. At Tomsk the astronomers were able to observe not only the total eclipse but the corona in a very satisfactory way. In most houses it was necessary to light candles or lamps. The eclipse began at 10.22 a.m., and ended at 11.46. The weather was very fine and the sky clear. At Krasnoyarsk, in the Government of Yeniseisk, the corona was very well photographed. At Irbit the period of absolute totality was at 8.44 a.m., and lasted 1½ minute. Prof. Stanoievich, from Belgrade, was very successful in his observations at Petrovsk ; he saw and photographed the green line in the corona. Prof. Kononovich, of Odessa, was equally fortunate, obtaining photographs of the whole spectrum. At Ekaterinburg the eclipse began in a cloudless sky at 7.25 a.m., and lasted till 9.30. The temperature fell from 19° C. to 13° (about 55½° F.) at 8.37 a.m., and rose to 24° (over 75° F.) after the eclipse. At Novocherkask the sky was cloudless, but only about a quarter of the sun's surface was obscured, the appearance presented being a reaping-hook with the handle and point uppermost. Photographic sketches were taken every five minutes. At Savidovo the sky became suddenly clouded as the moment of the eclipse approached, and the sun was not visible till noon. The actual moment of the total eclipse could only be noted by the intense darkness which suddenly spread over the whole district. Here and there a yellowish or leaden-gray tint could be distinguished in the clouds, presenting a most weird appearance ; and the strangeness of the scene was heightened by the profound disquiet and fear which seemed to have taken possession of the birds and the cattle in the fields.

PROF. YOUNG has returned from Russia, and is attending the Manchester meeting of the British Association.

THERE is a chance that, although the English Technical Education Bill has been abandoned, the corresponding Scotch measure may become law. The House of Commons went into Committee on the Bill on Monday night.

ACCORDING to the Meteorological Council, the telegrams received from the Ben Nevis Observatory have been of no service whatever as aids to the issue of storm warnings from the Meteorological Office. Mr. A. Buchan, in a letter to Mr. R. H. Scott, complains that the memorandum in which this judgment is pronounced is very misleading. "The finding of the memorandum," says Mr. Buchan, "is that the telegrams received from the Ben Nevis Observatory are absolutely useless to the Meteorological Office in issuing storm warnings. This statement is so incomplete that we do not think that in preparing the memorandum for your report the instructions have been kept in view which were sent to Mr. Omond, in accordance with your letter of December 3, 1883, a copy of which, so far as refers to this matter, is herewith sent. A copy of this letter was sent to Mr. Omond, with instructions to carry out your wishes to the best of his ability. Now, in these instructions to Mr. Omond no special mention is made of storms or storm warnings ; and certainly neither the directors nor the staff at the Observatory have ever supposed that it was expected by the Meteorological Office that a telegram was to be sent for every storm that had actually broken out or appeared to be threatened. This, however, is the assumption of the memorandum. We therefore think that in these circumstances the finding of the memorandum will be misleading to those of the public who have little or no knowledge of meteorological matters, and of the nature of the information asked from Ben Nevis Observatory ; and as regards others it may be considered as doubtful if the finding that weather telegrams from Ben Nevis Observatory are useless will be indorsed by them. As you are aware, the directors offered the Meteorological Office, in their letter of November 16, 1883, daily weather telegrams from both Ben Nevis Observatory and the low-level station at Fort William. This offer, however, the Meteorological Council did not see their way to accept, chiefly on the ground of the expense ; but asked for telegrams whenever any very striking change of conditions or a special phenomenon of great interest was recorded. This has been done by Mr. Omond, and, so far as the directors are aware, no application has been made by the Meteorological Office for more frequent telegrams or for any other information. The directors, in view, then, of the limited nature of the information asked for, would have been surprised if any other result had been found than that stated in the memorandum."

IN Mr. Symons's "British Rainfall," which we briefly reviewed last week, it is shown that the total fall in 1886 was rather above the average, but not exceptionally so, the amount being for England and Wales 37·53 inches, for Scotland 37·31 inches, and for Ireland (four stations only) 41·61 inches. The mean of all stations was 37·59 inches, or about 7 per cent. above the average for a long series of years. Some one ought now to discuss the observations with the view of showing the *probability* of rainfall for each month, and also with the view of showing the seasonal rainfall for the whole period now available.

MR. EDWARD SANGER SHEPHERD has sent us a very fine photograph of lightning taken by him at Norfolk Terrace, Westbourne Grove, W., during the thunder-storm of Wednesday, August 17. While the storm lasted Mr. Shepherd exposed fifteen plates, seven of which were successful. The apparatus used was a half-plate square box camera and a portrait lens of 1¾ inches aperture ; the plates used were "Ilford extra rapid."

IN a letter to the *Times* of Wednesday Prof. Tyndall called attention to the very imperfect way in which lightning conductors are often set up. Some years ago a rock lighthouse on the coast of Ireland was struck and damaged by lightning ; and when the facts were brought before Prof. Tyndall, as scientific adviser to the Trinity House and Board of Trade, he found that the lightning conductor had been carried down the lighthouse tower, its lower extremity being carefully embedded in a stone perforated to receive it. "If the object," says Prof. Tyndall, "had been to invite the lightning to strike the tower, a better arrangement could hardly have been adopted. I gave directions to have the conductor immediately prolonged, and to have added to it a large terminal plate of copper, which was to be completely submerged in the sea. The obvious convenience of a chain as a prolongation of the conductor caused the authorities in Ireland to propose it, but I was obliged to veto the adoption of the chain. The contact of link with link is never perfect. I had, moreover, beside me a portion of a chain cable through which a lightning discharge had passed, the electricity in passing from link to link encountering a resistance sufficient to enable it to partially fuse the chain. The abolition of resistance is absolutely necessary in connecting a lightning conductor with the earth, and this is done by closely embedding in the earth a plate of good conducting material and of large area. The largeness of area makes atonement for the imperfect conductivity of earth. The plate, in fact, constitutes a wide door through which the electricity passes freely into the earth, its disruptive and damaging effects being thereby avoided." Prof. Tyndall understands that lightning conductors are frequently set up without any terminal plate whatever. It is said that the Bishop of Winchester's palace at Farnham is "protected" in this way. If this is true, the Bishop will be interested to hear that the "protection" is "a mockery, a delusion, and a snare."

WE have received the twelfth Report of the Bradford Philosophical Society. This institution was revived two years ago, and we are glad to see from the Report that it has "a bright prospect of success." The Society is closely associated with a group of affiliated Societies in Bradford, and it has been found that this plan works well. "The joint programme of the Societies," says the Report, "is one that reflects great credit on the town, and members of the Philosophical Society would do well to avail themselves (as their membership allows) of the various lectures and excursions of the united Societies. Members of the Society may be assured of a hearty welcome." The affiliated Societies are the Historical and Antiquarian Society, the Microscopical Society, the Naturalists' Society, the Scientific Association, and the Browning Society.

LIEUT. WISSMANN, the well-known African traveller, has arrived at Mozambique. He intends to proceed to Zanzibar on his way back to Europe.

THREE large packages containing rare plants and specimens from India have been received from Calcutta by the Keeper of the Ethnographical Department of the British Museum.

A SHOCK of earthquake was felt in Mexico at seven o'clock on Monday morning. The houses were shaken and the inhabitants much terrified, but no damage was done. The direction of the shock was from north to south. The shock was also felt at Chilpancingo, where two arches of an arcade in the main square were demolished, at Orizaba, Tlaltan, and Otumba.

A LARGE proportion of the salmon fry hatched out by the Severn Fishery Board at the new hatchery at Worcester this year are being reared by Mr. William Burgess in his ponds at Malvern Wells, pending their transference to the open river. It is worthy of note that the fry may be seen rising continually to the fly. Seeing that they inhabit the bottom of the river in their wild state and do not rise, this is rather remarkable. Their rate of growth does not seem to be so fast as that of other fish, although their present position is well suited to their requirements.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*) from India, presented by Miss Austin; a —— Capuchin (*Cebus* ——) from South America, presented by Mr. J. H. Williams; two Horned Lizards (*Phrynosoma cornutum*) from North America, presented by Mr. Maxwell Blackie; two Common Boas (*Boa constrictor*) from Dominica, W.I., presented by Mr. A. Nicholls; Smooth Snake (*Coronella lævis*) from Hampshire, presented by Mr. Sidney G. Smith; a Lion Marmoset (*Midas rosalia*), a Peba Armadillo (*Tatusia peba*), two Blue-bearded Jays (*Cyanocorax cyanopogon*), an Ariel Toucan (*Ramphastos ariel*), three Bahama Ducks (*Dafila bahamensis*), a Laughing Gull (*Larus atricilla*) from Brazil, a Black-handed Spider Monkey (*Ateles melanochir* ♀) from Central America, eight Blanding's Terrapins (*Clemmys blandingi*) from Michigan, U.S.A., purchased; two Hybrid Australian Ibises (between *Ibis strictipennis* and *Ibis bernieri*) bred in the Gardens.

## OUR ASTRONOMICAL COLUMN

VARIABLE STAR IN THE RING NEBULA IN LYRA.—Herr Spitaler draws attention in the *Astronomische Nachricten*, No. 2800, to the apparent variability of the small star near the centre of this well-known nebula. He had made himself pretty well acquainted with the nebula in September 1885, when he had sketched it, but was induced to examine it again last autumn from the note on the "ring-formed nucleus" discovered by means of photography, which Herr E. von Gothard had published in the *Astronomische Nachricten*, No. 2749. The interior of the ring nebula appeared with a low power to be covered with a faint curtain of light, which a high power showed to be of varying intensity, so that the interior had a faint flocculent appearance; a bright speck of light was also easily recognized midway between the centre of the nebula and the inner edge of the ring on the south-west side. In the eastern portion three faint stars were seen several times, but a fourth star seen by Prof. Vogel, and shown on the photographs of the Bros. Henry, could not be made out. But on July 25 of the present year, during the visit of Prof. Young to the Vienna Observatory, on the telescope being again turned to the nebula a small star was seen at the first glance a very little north-west of the centre, just as it is shown in the Gothard photograph, but a little fainter. The following night it was seen again, but not so distinctly. The star would therefore appear to be variable, and well worth watching. The evidence of Herr von Gothard's photograph, which shows it, whilst a faint star in the neighbourhood is not represented, seems to indicate that it is particularly rich in actinic light.

NEW VARIABLE STAR.—Mr. Espin announces in Circular No. 17 of the Wolsingham Observatory that the star Birmingham 541 is variable from 6·6 ± to 8·0 ±. The star's place for 1887 is R.A. 20h. 9m. 17s; Decl. 33° 22′·0 N.

DISCOVERY OF A COMET.—Mr. W. R. Brooks, Red House Observatory, Phelps, New York, discovered a comet on August 24, 20h. 53m. G.M.T. Place of the comet, R.A. 8h. 33m., Decl. 29° 0′ N. It seems probable that this object is the expected comet of Olbers.

## ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 SEPTEMBER 4-10.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on September* 4

Sun rises, 5h. 19m.; souths, 11h. 58m. 58·3s.; sets, 18h. 39m.; decl. on meridian, 7° 13′ N.: Sidereal Time at Sunset, 17h. 33m.

Moon (at Last Quarter Sept. 10, 15h.) rises, 19h. 25m.*; souths, 1h. 9m.; sets, 7h. 4m.; decl. on meridian, 3° 39′ S.

| Planet. | Rises. | | Souths. | | Sets. | | Decl. on meridian. | | |
|---|---|---|---|---|---|---|---|---|---|
| | h. | m. | h. | m. | h. | m. | ° | ′ | |
| Mercury | 4 | 38 | 11 | 39 | 18 | 40 | 11 | 8 | N. |
| Venus | 8 | 0 | 13 | 17 | 18 | 34 | 9 | 8 | S. |
| Mars | 1 | 46 | 9 | 39 | 17 | 32 | 19 | 59 | N. |
| Jupiter | 10 | 7 | 15 | 11 | 20 | 15 | 11 | 35 | S. |
| Saturn | 1 | 31 | 9 | 24 | 17 | 17 | 19 | 57 | S. |

* Indicates that the rising is that of the preceding evening.

| Sept. | h. | |
|---|---|---|
| 10 | 18 | Mercury in superior conjunction with the Sun. |